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of scientific truth. For a short statement of my views on this subject I refer the reader to my pamphlet, *The Philosophy of Form*.

Any truth once stated will remain true. Our conception of truth to-day may later prove to be insufficient and will change in so far as it will have to be stated more broadly as soon as we have discovered truths that are supplementary. Thus the truth of to-day will have to be amplified by the new truths of to-morrow, but if a truth is correctly stated to-day it will never become an untruth or a lie. The truth of to-day will always remain a truth, although it may become a stepping-stone for a higher truth that will be broader and more exact. Such are scientific truths. The shape of the earth was as good as flat to the Egyptian peasant, but the "flatness" of the earth really referred at that time only to the valley of the Nile, not to the whole earth. The conception of flatness of the earth as a whole was never true. Even though the Egyptian farmer may not have had the data in his hands by which he could disprove his incorrect notion; even though there may be many conceptions which are erroneous or purely subjective, and which we could never disprove, still the ideal of truth remains as significant and indispensable for science as our confidence in and reliance upon methodologically systematized knowledge, in other words, our confidence in science.

Here lies the main error of pragmatism.

According to the belief of Professor James's friend, Mr. Charles S. Peirce, the pragmatic applicability of truth is most essential, and the theory of gravitation would find serious refutation to-day if it would be to any one's pecuniary advantage to deny Newton's view of gravitation. That the theory of gravitation has been accepted, is, as Mr. Peirce suggested, mainly due to the fact that there were no pecuniary or practical interests that militated against its acceptability. This may or may not be true; at any rate I am not prepared to deny it. I believe that pragmatism carries the practical criterion of truth to a degree where it becomes actually dangerous to our philosophical well-being. EDITOR.

EVEN ORDER MAGIC SQUARES WITH PRIME NUMBERS.

THEIR CONSTRUCTION BY THE METHOD OF "PSEUDO-COMPLEMENTARIES."

Although this method was devised primarily for, and is explained in, the present article in connection with prime number magic squares, it is applicable to other series of numbers, though the nature of the latter generally allows the employment of simpler methods. With the following method it will be noted that squares of orders $8p \pm 2$ do not involve any extra difficulties in constructing, as is quite common among other methods.

Fig. 1 is an example of the lowest order of squares constructed by this method, and the arrangement of its normal complementaries is shown in Fig. 2, the heavy lines connecting the two cells of each complementary couplet. This uniformity of complementary arrangement is identical for all orders concerned.

As an example we will explain the application of this method to a square of the sixth order; but first let us note the character of the pseudo-complementaries.

613	239	647	181
491	337	769	83
349	503	71	757
227	601	193	659

S=1680

Fig. 1.

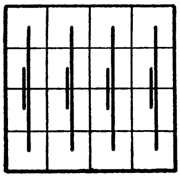


Fig. 2.

A C B

8	9	24	25	40	41
7	10	23	26	39	42
6	11	22	27	38	43
5	12	21	28	37	44
4	13	20	29	36	45
3	14	19	30	35	46
2	15	18	31	34	47
1	16	17	32	33	48

A C B

Fig. 3.

In Fig. 3 we have a table with *n* vertical columns and an indefinite number (in this case 8) of horizontal rows. This table was arranged by placing 1 in the lower left-hand cell, and numbering the cells in sequence, up in the first column, down in the second, up in the third, etc., until the table was filled. A line A—A is drawn between the first and second columns, and the line B—B centrally divides the remaining columns. The line C—C centrally divides the whole system.

It will be noticed that all horizontal pairs balanced on the line A—A have equal values. This also applies respectively to lines B—B and C—C. The pairs about the line C—C are *normal com-*

plementaries, while those about the line A—A or the line B—B are *pseudo-complementaries.* For convenience of explanation in the present writing we will classify the latter according to their rank with the normal complementaries, those about the line A—A being *minor* and those about the line B—B being *major.* It should be understood however that more than two sets of pseudo-complementaries may be used in larger squares, their number depending on the size of the square.

A complementary row of Fig. 3 is shown in Fig. 4, which plainly shows the relation of the normal and pseudo-complementaries. Each minor complementary = 17, each major = 65, and each normal = 49. Also, referring to Fig. 3, it will be noticed that the sum of one minor and two majors is equal to three normals regardless of their relative position, for example, (6+11) + (24+41) + (19+46) = (23+26) + (2+47) + (16+33).

Another feature to be observed is that each number of a pseudo-pair has its own respective normal complementary, for example, in the pair 8,9: 8 is normal to 41, and 9 is normal to 40; also, in the pair, 23,42: 23 is normal to 26 and 42 is normal to 7.

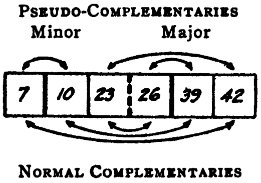


Fig. 4.

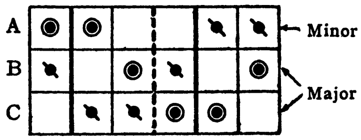


Fig. 5.

These pseudo-pairs with their normal complementaries we will call for convenience *complementary sets,* and these are shown diagrammatically in Fig. 5. The upper line A represents a minor set, while B and C represent major sets, the minor and major classification being only in respect to the pairs shown with dots enclosed in circles, because these are used in constructing the square, while the pairs represented by dots with a line drawn through are used only when selecting sets from the prime number table.

Let us now pass on to the construction of this table and the selection of prime number sets.

Referring to Fig. 6, the horizontal rows should contain *n* cells (in this case 6). The number of cells in the vertical columns must be learned by experiment so as to allow for a selection of a sufficient

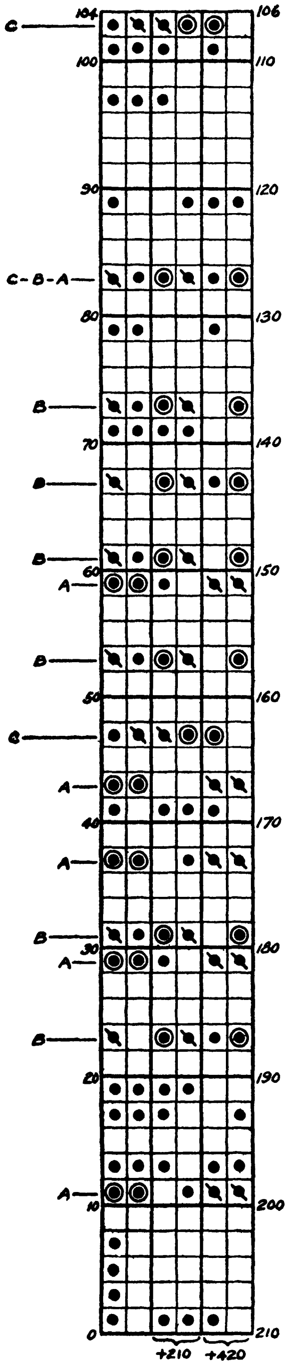
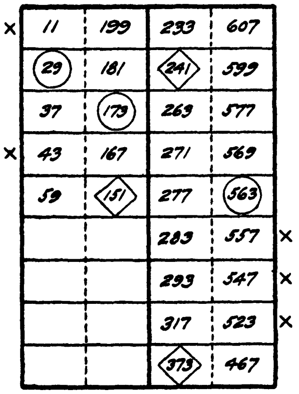
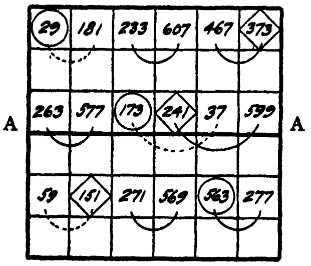


Fig. 6.



X	11	199	233	607	
	29	181	241	599	
	37	173	263	577	
X	43	167	271	569	
	59	151	277	563	
			283	557	X
			293	547	X
			317	523	X
			373	467	

Fig. 7.



	29	181	233	607	467	373	
A	263	577	173	241	37	599	A
	59	151	271	569	563	277	

Fig. 8.

29	181	233	607	467	373
571	479	359	61	67	353
263	577	173	241	37	599
367	53	457	389	593	31
59	151	271	569	563	277
601	449	397	23	163	257

S=1890

Fig. 9.

number of complementary sets to build the square. The number of sets necessary is $(n/2)^2$ and of these $n/2$ must be minor sets.

There is one essential rule however governing the length of the table; that is, to create the maximum number of complementary sets the numerical advance of each double column should be a *factorial increment* or its multiple. In Fig. 6 the increment is 210, which is the product of the prime factors 2, 3, 5, and 7.

In making the table it is necessary to include the cells in which even numbers would fall, therefore this table is made for odd numbers only. To fill the table we count by odd numbers in the same procession as we did in Fig. 3, but a number is placed in its cell only when it is prime. (In Fig. 6 we have used dots instead of the numbers, their value being determined by the index numbers at the sides and bottom.)

We now select sets as indicated in Fig. 5, the letters at the left of the table indicating the respective sets. In the line C, B, A, either of these respective sets may be chosen. The dots enclosed in circles indicate the pseudo-pair to be used for construction, *and each end of these dots must have a normal complementary, which are shown with lines drawn through.*

The pseudo-complementaries are now placed in table form as shown in Fig. 7. That is, the prime numbers represented by dots enclosed in circles are transferred to a double-column table with the minor pairs in one column and major pairs in the other.

From this last table we select the diagonals. Two sets of $n/2$ (in this case three) numbers each are found which have equal sums. Two sets are indicated in Fig. 7, one set enclosed by squares and the other by circles, the sum of each being 765. Care must be taken not to have the two numbers of one pair contained in the same set, neither should there be more than $n/2$ minor pairs involved in this selection for diagonals.

One of these sets of three numbers is spaced in every second cell diagonally down to the right in the blank square, and the other set is placed diagonally down to the left as in Fig. 8.

The nine pseudo-pairs are now filled in completing the horizontal rows in which the six diagonal numbers fell, so that each row will contain one minor and two major pairs. By so doing we find that in Fig. 7 we have a surplus of pairs not needed, which are marked by an x at the side.

The arrangement of the pseudo-pairs in Fig. 8 is indicated by the curved lines which connect the numbers of each pair, the dotted

929	307	821	1327	773	1279	113	1171
1193	1453	1201	43	1217	59	1487	67
1523	271	577	1481	619	733	149	1367
1123	1489	1181	1451	1019	79	241	137
557	191	499	229	661	1601	1439	1543
157	1409	1103	199	1061	947	1531	313
487	227	479	1637	463	1621	193	1613
751	1373	859	353	907	401	1567	509

S = 6720

Fig. 10.

31	599	691	3089	739	3041	757	3023	2971	809
853	1667	1979	541	2879	2791	1949	571	1367	1153
811	2969	769	3011	761	3019	479	151	1013	2767
2063	457	673	1847	2939	2731	1873	647	2053	467
1039	2741	29	2833	947	1061	2719	601	1051	2729
2111	409	3121	317	2203	2089	431	2549	2099	421
1087	2693	2477	1303	211	419	1277	2503	1097	2683
2339	181	2381	139	2389	131	2671	2999	2137	383
2297	1483	1171	2609	271	359	1201	2579	1783	1997
3119	2551	2459	61	2411	109	2393	127	179	2341

S = 15750

Fig. 11.

lines indicating the minors and the full lines indicating the majors.

The square is now half filled, and is completed by placing the normal complementary of each of these numbers vertically opposite to the line A—A and equidistant from it. This also completes the

263	367	701	3709	643	3767	1933	2477	719	3691	3719	691
1277	1873	3727	3203	1979	1171	1949	1201	1901	1249	1667	1483
241	389	1051	3359	853	3557	863	3547	3463	947	977	3433
3673	3257	1069	2081	1913	1237	2213	937	2221	929	2027	1123
197	433	1039	3371	1091	3319	3361	1049	2039	2371	1087	3323
3671	3259	2683	467	593	2557	2341	809	2671	479	2551	599
109	521	1097	3313	3187	1223	1439	2971	1109	3301	1229	3181
3583	3347	2741	409	2689	461	419	2731	1741	1409	2693	457
107	523	2711	1699	1867	2543	1567	2843	1559	2851	1753	2657
3539	3391	2729	421	2927	223	2917	233	317	2833	2803	347
2503	1907	53	577	1801	2609	1831	2579	1879	2531	2113	2297
3517	3413	3079	71	3137	13	1847	1303	3061	89	61	3089

S=22680

Fig. 12.

167	509	673	863	331	1237
383	1259	1231	421	449	37
887	613	487	227	353	1213
373	647	773	1033	907	47
877	1	29	839	811	1223
1093	751	587	397	929	23

S=3780

601	797	239	947	43	1153
997	1249	151	431	269	683
199	599	641	1069	241	1031
1061	661	619	191	1019	229
263	11	1109	829	991	577
659	463	1021	313	1217	107

S=3780

Fig. 13.

diagonals, as we will now explain. The three diagonal numbers 29, 173 and 563, with their normal complementaries, would give the magic summation, but their complementaries cannot be used to complete the diagonal because of their vertical arrangement (see Fig. 2). But since the diagonal numbers $29+173+563=151+241+373$, the normal complementaries of the above two sets must be equal; therefore, $(29+173+563)+$ the normal complementaries of $(151+241+373)=$ the magic summation. By inspecting the completed square, Fig. 9, it will be found that the two diagonals are corrected as above described.

Examples of the eighth, tenth and twelfth orders are shown in Figs. 10, 11 and 12 respectively.

Fig. 13 is an example of twin squares. These are constructed by selecting a sufficient number of complementary sets to supply two squares of like summations.

HARRY A. SAYLES.

SCHENECTADY, N. Y.

THE GRAMMAR OF IDO.

The desire to establish an international language which should serve as an auxiliary means of communication between different nationalities has developed the new world language "Ido," which is practically a revision of Esperanto. A "Delegation for the Introduction of an International Language" was formed in 1901 during the World's Fair at Paris, and in 1907 an international committee of specialists chosen by them held a meeting at Paris in the College of France under Prof. Wilhelm Ostwald as chairman. After eighteen sessions the committee decided that Esperanto was the best international language but that it needed many improvements, and a new institute, the "Ido Academy," was entrusted with the task of revision. In carrying on the work they observed the following principles:

1. The alphabet is without accents, so as to avoid typographical difficulties, and remove all objection to using it in telegrams.
2. The adjectives are indeclinable as in English and the objective case is the same as the subjective, except when the object precedes the subject.
3. The derivation of words follows strictly logical rules.